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Treatment of Saline Water in South Khartoum Sector

A Thesis Submitted in partial Fulfillment of the Requirement for the degree of Master in Industrial Chemistry

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الآيـــــــة

قَالَ تَعَالَىٰ:

﴿ إِنَّ فِي خَلْقِ ٱلسَّمَٰوَٰتِ وَٱلْأَرْضِ وَٱخْتِلَٰفِ ٱلَّيْلِ وَٱلنَّهَارِ وَٱلْفُلْكِ ٱلَّتِي تَجْرِي فِي ٱلْبَحْرِ بِمَا يَنفَعُ ٱلنَّاسَ وَمَآ أَنزَلَ ٱللَّهُ مِنَ ٱلسَّمَآءِ مِن مَّآءٍ فَأَحْيَا بِهِ ٱلْأَرْضَ بَعْدَ مَوْتِهَا وَبَثَّ فِيهَا مِن كُلِّ دَآبَّةٍ وَتَصْرِيفِ ٱلرِّيَٰحِ وَٱلسَّحَابِ ٱلْمُسَخَّرِ بَيْنَ ٱلسَّمَآءِ وَٱلْأَرْضِ لَأٓيَٰتٍ لِّقَوْمٍ يَعْقِلُونَ ﴿١٦٤﴾ ﴾

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Dedication

` To the spring that never stops flowing. To my mother who weave the string of my happiness with the Merciful heart of her.

To whom who strives the bless comfort and welfare and never stints what he owns pushing me to the way of success, who taught me how to take the first step in my life with patient.

To those whose love flows within my veins and heart, always in mind.

To my brothers and sisters.

To the sisters who supported me much ….

To all my friends

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Abstract

The study aims at analyzing the water of some areas in the state of South Khartoum, Finding methods for its treatment. Many chemical analysis were made including (Estimating the proportion of Chemical elements in Samples), and the physical analysis which composed of (testing turbidity, alkalinity, total hardness, conductivity, the amount of dissolved salts and pH) with the use of many appliances such as spectrofotometer, conductivity, flame photometer, photometer, atomic absorption and the pH meter.

Many finings were reached such as:

An increase in soluable salts, alkalinity and hardness in the area of Jabra (Taha Al- Mahi station) and its decrease in Al – Sahafa area, Station (7) and Africa University.

The increase in the percentage of phosphate for all area from which sample are taken, Jabra-Taha- Al- Mahi, Al-Sahafa (7), Arkwait (69), Africa University).

All of these tests are conducted according to verifying the validity and existence of salts in them and also bacteria.

مستخلص البحث

تم في هذه الدراسة تحليل مياه بعض المناطق في ولاية جنوب الخرطوم ، وإيجاد طرق لمعالجتها ، حيث أجريت العديد من التحاليل الكيمائية التي تشمل (تقدير نسبة العناصر الكيميائية في العينات) والتحاليل الفيزيائية التي تشمل (اختيار العكارة والقاعدية والصلابة والتوصيلية وكمية الأملاح الذائبة والpH باستخدام العديد من الأجهزة مثل الاسبكتروفوتميتر وجهاز الـ (pH) وجهاز التوصيلية وجهاز الامتصاص الذري واللهبي والفوتوميتر .وتحصلت على مختلف النتائج من (زيادة في كمية الأملاح الذائبة والقاعدية والعسر في منطقة (جبرة محطة طه الماحي ونقصها في منطقة الصحافة محطة (7) وجامعة أفريقيا)، وزيادة نسبة الفوسفات في جميع المناطق التي أخذت منها العينات (جبرة ، طه الماحي ، الصحافة (7) أركويت (69) ، جامعة أفريقيا ، وكانت كل هذه الاختبارات وفقاً للتحقق من صلاحية المياه للشرب ، حيث وجدت أنها غير صالحة بسبب ارتفاع الفوسفات ووجود الأملاح واحتواءها على البكتيريا .

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Chapter One

Introduction

Chapter One

Introduction

1.1 Introduction:

The interest of the human on quality of the water he drinks was more than five thousand years. Given the limited knowledgeof diseasesin those agesand their causes ,The interest has been limited in water taste and smell only. I have used for this purpose, and to a limited extent during spacedhistorical periods, some treatment processes such as boiling , filtration , sedimentation and adding some salt. The eighteenth and nineteenth centuries witness a lot of serious attempts in Europe, Russia and the countries for the advancement of technology,of water treatment, where established for the first time in history, water treatment plants at the level of the cities . In 1807 station was set up for water treatment in the city of Glaxo Scottish, This station is one of the first stations in the world where water was treated in a manner refining and then transported to consumers via the private network pipes. And despite the fact that those contributions are technologically advanced in that period, interest at that time was provided for the aspects of color, taste and smell, or the so-called susceptibility, and was treated by using sand filters prevailing in those stations until the beginning of the twentieth century.

However with overall development of science and technology since the beginning of the century the relationship between drinking water and some diseases prevailing is discover.A rapid development in the field of processing techniques,has taken place adding many processes generally aiming obtaining water of high of purity,free of turbidity,colorless,teste and smell .

1.2 Research Objectives:

Analysis and treatment of water in South Khartoum State.

1.3 The Research Problem:

Due to acontamination of water of south Khartoum with many pollutants .it loses natural properties(color,smell and tasting), and causes many of diseases, so that were conducted many tests :

1-Chemical tests.

2-Physical tests.

3-Biochemical tests .

1.4 The Importance of The Research :

To Study the Elements in the waters of the state of the South Khartoum and determine the extent of the amount of dissolved salts , total hardness , alkaline water , calculating the concentration of pH and knowledge of turbidity ratio of water to the state of South Khartoum.

Chapter Two

Literature Review

Chapter Two

Literature Review

2.1 Introduction:

The literature include, the theoretical frame work and also the most important of element of the research, where this chapter about water and its importance, existence, necessity for life, composition and sources of the chemical ,physical and biochemical properties .

TheWater:

Water existent free in seas and oceans, which cover about 70% of the Earth's surface. Some of the water also exist under the earth's surface of the earth on the ground water body, which sometimes show the Earth's surface on the body springs from which water and steam, water and also there is a steam Authority the air rate of up to about 4% in some areas. When the steam cools falls on the Earth's surface to form rain. There are water united in a lot of rocks on the planet amorphous body of water, as the water fills the living organisms as animal and plant cells, which is the medium where all interactions take place in the bodies of these organisms.

2.1.1 The Importance of Water in General:

Water is an essential element for forming the human body, animals and plants, and the water represents about 75% of the composition of the human body and about 90% of the plant body, and thus there is no biological process whiten the body of the living organism, unless there is a percentage of water.

1-Water helps to chew, swallow, digest and absorb food.

2- The water enters in the structures of all body secretions.

3- Water helps in dissolving waste and helps in disposing with urine and sweat.

4- Works to regulate body temperature.

5-Plant could not get what it needs from the food substance found in the soil, except dissolved way.

6-Water is very essential for cleaning and disposal of the dirt.

7- Water is the most common solvents and for cheapest for regard to price and in industrial processes.

8- It is used for cooling in various processes in factories.

9-Extracted from water massive amounts of fish and marine, river creatureareextracted.

10–Water inter in the preparation of a lot of products, especially the food.

11- Waterworks as a medium to carry the ships transporting goods and passengers[3]

(A)-Water is the Fountain of Life:

To find water was at the forefront of space expeditions since the end of the fifties and that is for one reason that the presence of water is considered an early warning device reveals the existence of life in this spot or that of any planet.

Water is considered a sign of life disorder, as is the case in certain parts of Canada where scientists found frog distorted because of water pollution and the World Health Organization estimates that nearly a billion people on the planet is

deprived of clean drinking water and that this number will triple in the coming years and 30,000 people die daily from drinking contaminated water.

Scientists also believe there is a relationship between cancer and water purification installations. Water covers two-thirds of the planet, but the fresh water rate is very small.

However fresh water consumption has quadrupled over the past fifty yearsand the industrial development adds a burden on the water problem because the World Health Organization estimates that 33% of the amount consumed globally is used in industry, cleaning, heating and cooling. According to the estimation of scientists the volume of water that covers the globe reach 1.5 billion square kilometers "1"

(B)-The Need of Fresh Water for Health:

Water constitutes 90% of the complex system and the source of humansthinking, this is the brain, composed of water. 70% of the heart components and 86% of the lungs and liver and 83% of the kidneys and 75% of the various muscles of the body, and 83% of the blood and the water is very necessary for health, because all vital bodily functions depends on pure water in their work, therefore man dies after a period of interruption of water from his body. Scientists and human health specialist advised to drink enoughfresh water per day to avoid a lot of health complications.

It is natural that the need for water in humans isdetermined by the amount of water lost from the body as , scientists estimate that the average person loses about 3 liters a day of water through lactation, sweat and breathing.Human gets half of what he needs from the water than other drinks, also about 0.3 liters in addition obtained by the body from the oxidation of foods ,and the

bodyhassensitive early warning system that warned it through the feeling thirst ..80% from the body water is sufficient to operate this system to refresh the dryness of lips and throat. The elderly suffer more than others from the symptoms of a lack of water due to the weakness of the warning they have due to advancing age and lower feelingfor the need of water.

Specifications in the civilized world are keen on the arrival of drinking water to human health, and the danger comes from nitrates in the water sometimes, that is a substance widely used in fertilizers and seep into the water and adds specialists calcium in the water.

2.1.2 Installation of Water:

The prevailing belief in ancient times that water is simple element that cannot be analyzedin to other simplercomponents .until the English scientistCavendish explained the that water is made up of the Union of two sizes of hydrogen and one of oxygen gas volume, when the electrolysis of water separates into its components which are oxygen and hydrogen. Water atomic number is 8 and weighed 16, and water is made up from chemical reactions, especially in interactions between acids and bases, such as the following chemical reaction:

$$NaOH + HCl \rightarrow NaCl + H_2O \qquad (2.1)$$

There are more than one type of water molecules, the usual oxygen may combine with hydrogen isotopes that are Aldioniriom, Althereciom and so three types of water are made up:

$$TaOH + HCl \rightarrow TaCl + H_2O \qquad (2.2)$$

Water molecule is not in linearly, in which three atoms have on a single line, but is curved molecule in which the center of positive charge of the two hydrogen

molecule does not match the negative oxygen positive atoms thus it resembles magent having a negative positive polars, for this is said to be water molecules polar molecules, that such polar duplication contributes to the hydrogen bonds between water molecules to bind with ions such as sodium and chlorine in food salt, which take full electric charged, and helps the formation of other bilateral molecules polar and so water is consider the strongest of solvents especially for those polar material "4".

In contrast, the substances consisting of uncharged particles and does not have a dipole distribution do not dissolve in water, the nearest example is the solvent, which consists of hydrocarbon molecules contain only hydrogen atoms and carbon atoms nor are any of them viability of a powerful magnet for electrons.

A- Aggregation of Water Molecules:

Polar property lead to aggregation of water molecules in which one of the hydrogen atoms are attracted to one of the molecules (the positive terminal) to the oxygen atom in the other molecule (the negative terminal) and consists of what is known as hydrogen bonding between different molecules, and increasingly this compilation lower temperatures, which leads to the emergence of the anomalous properties of water in many of the natural properties.

2.1.3 Natural Water Sources:

The most important natural water sources are the rain and sea water, oceans, rivers, lakes, water refrigerators and groundwater, and these types do not differ in the chemical composition of the waters, but may differ in some of the contents of this water "3".

(A) RainWater:

When air temperature reduced the water vapor condenses in the air and fall to the earth's surface in the form of rain or snow depending on the weather conditions prevailing and rainwater is consider the purest form natural water .But itmay melt some of the gases that are airborneespecially, during falling industrial areas in which the rate of carbon dioxide sulfur dioxide increase.there fall in these areas and its surrounding the so-called acid-laden rain acids resulting from these gases when it dissolves in the rain water, causing the rain a lot of damage to the environment that falls on them, as spoil Lakes water.

(B) Seas and Oceans:

Seas and oceans contain a proportion of dissolved salts reach about 3.5%. This rate exceeding that in some closed seas, especially in hot, dry areas where rain fall, and sodium chloride form about 70% of the amount of dissolved salts in seawater and bromine compounds, sulfur, iodine , in addition to phosphorus, Barium, aluminum and some organic compounds resulting from the remains of dead marine organisms vehicles.

The seas and oceans also contains some air gases such as oxygen, nitrogen and carbon dioxide in sea water to about 50% double for being in the air, it is in the air by the rate of 1.5%, and in the air only 0.3%, which is a major source of carbon element for organisms living marine.

(C) Water Refrigerators:

Mountain Refrigerators formed when ice sheets collapsing which cover the mountains surfaces in cold regions and move these refrigerators slowly in the form

of a river of ice and when they reach a warm area which melts the ice component of natural rivers or one of the lakes.

The Gaseousmetallic refrigerators exist in the form of a massive cover of ice, as is the case in Antarctica or Greenland, and thickness of the ice layers may reach to a thousand meters or more in some cases. they can in some time affect the ocean water level, any increase in the amount of the ice content is matched by a similar decrease in the level of the ocean surface, and when moving the refrigerator gas in the direction of the sea a large amount of ice separates and floaton the surface of the water and called the mountains of floating ice [3].

(D) The Waters of Rivers and Lakes:

Rivers and lakes are consider of the most important water Homestead sources, which contain small concentrations of salts ranging 50-100 ppm, which could carry river water some outstanding material and created rivers of rain on some mountainous areas which are then filled valleys or fill some of the depressions composing lakes.

(E) Ground water:

Groundwater arising from rainwater leaking into the ground. Most groundwater water is manor, but some of them may contain types of salts of up to about 200-300 ppm and upon the arrival of these salts to 400 ppm become invalid and is known (barkish water) and groundwater in some areas comes in the form of springs, where the water has been retained by steam, and some waters are used in medical treatment for it contain salts such as sodium and magnesium sulphate [3].

2.1.4 Physical and Chemical Properties of Drinking Water:

We will talk in this section of the water quality, depending on the World Health Organization standards (WHO) and the Association of American International Health (APHS) and public health standards for the environment, it expressed in concentrations elements and ions By mg/l per liter or parts per million (ppm).

Depending on the US Salinity Laboratory (1954) groud water quality classified dependent on (Mg/l), the total amount of dissolved salts in terms of:

Table 2.1: Total amount of dissolved salts (TDS) according to the US salinity laboratory (1954)

Water Type	TDS
Fresh water	Less than 1,000
Brackish water	From 8,000 to 10,000
valid water	From 10000 to 35000
Salty water	More than 35,000

The total dissolved salts in sea water around 34000mg/l The total dissolved salts in the water allowed to be used for drinking and human uses about 500 mg/l but the a total dissolved salts can be twice or three times as much in the case of non-availability of good water.

2.1.5 The Physical Properties of Water:

Water is a colorless, odorless, and molecular weight is 18 at 100 centigrat under normal atmospheric pressure and turns to ice at zero centigrade.

(A) Boiling and Freezing:

The boiling point of water vary depending on the pressure upon it. It boils at 100 centigreat under the pressure of 760 Hg (atmospheric pressure normally equal to one atmosphere. And boils at 100centigreatin for some boiler steam reservoirs under several atmospheres pressure and boils at 90centigreatabove the mountain height of the top 3 kilometers because of the low atmospheric pressure and the critical temperature of the water.(5)

(B) **Density**:

When lowering the temperature of a substance it size decrease and density increasing water follows the this rule within certain limits upon lowering the water temperatureits density begins to increase until it reaches the highest value, when the water temperature at 4 water does follow this rule, and upon the continuation of lowering the temperature it begins to increase in density and the water turns to ice."10"

The density of water at 100 C^0 0.985 g / cm^3

The density of water at 4C^0 1.00 g /cm^3.

The density of Water at Zero Centigrade 0.999 g /cm^3

The reason for this abnormal behavior is that water molecules are in the form of ice there are together in a steady-state and do not have freedom of movement when raising the temperature from zero to 4^c disintegrate hydrogen bonds and make these molecules have some freedom of movement , and become closeeach other and reducing the size and rises density from 0.999 to 1.00m and after that the water molecules starts spacing from each other to raise the

temperature even more than that, up to 100 c and water density become 0.985 g / cm^3.

(C) The Latent Heat of Escalation:

Liquid needs to absorb some amount of heat until it turns from liquid to vapor and known as latent escalation heat, which is usually defined amount of heat needed to convert one gram of material from liquid to vapor without rising temperature of the material.

2.1.6Chemical Properties of Water:

(A) The Disintegration of the Water:

Water molecules Break when electric spark pass in the water vapor and thus the result of the mixture of hydrogen and oxygen from dissociation process cools rapidly in water vapor and cannot find suitable conditions for the re-formation of water molecules and dissociation ratedoes not increase more than 0.02% at a temperature of 2600 ^{0}C.

(B) Interaction withMetals:

Water reacts with alkali metals such as sodium forming sodium hydroxide with the escalation of hydrogen gas.

$$2\ Na + 2H_2O \rightarrow 2NaOH + H_2 \qquad (2.3)$$

Calcium metal reacts in the same way forming hydroxide, and magnesium, iron and zinc, do not react except water vapor.

(C) The Water Reacts with Halogens:

such as chlorine forming chlorine water which is a mixture of hydrochloric acid. and hypochlorouse acid

$$H_2O + CI_2 \rightarrow HCl + HOCl \qquad (2.4)$$

The water reacts with halides phosphorus forming phosphorus acids according to the following equations:

$$PCL_2 + 4H_2O \rightarrow H_3PO_3 + 5HCL \qquad (2.5)$$

Water reacts with carbon when pass the steam on heated coal to 1000^c and in this case water gas is formed.

$$C + H_2O + \rightarrow CO + H_2 \qquad (2.6)$$

(D) Water Hardness:

Water hardness is the sum of the concentrations of ions of calcium, magnesium, and (iron and aluminum), have a great concentration, water hardness is display through the use of soap. The soap deposited by ions of calcium and magnesium, and units hardnessexpressed by mg/l of calcium carbonate and magnesium, and this hardness is called total hardness and equal calcium hardness + hardness of magnesium. and it is calculated by adding the equivalent of calcium and magnesium per liter and hits a total of 50 and water hardness is classified by mg/l from $caco_3$ as in the following Table:

Table 2.2: Classification of water hardness from calcium carbonate:

Water Type	mg per liter of $CaCO_3$
Water hardness	Zero to 60
Medium brackish water	60 to 120
Water hardness	120 to 180
Water hardness is very	More than 180

(E) Types of hardness:

1-temporary hardship: a calcium hardness and magnesium on the form of calcium bicarbonate and magnesium, treated by heating tomake watersoft.

2-permanent hardship: This is the result of sulphates and chloridesit is not bicarbonate. This type is not treated by the heat. For home use hardness of water must not exceed 80mg/l.

The hardness of water produced from limestone and gypsum will be from 200 to 30 mg/l.

Water hardness is a form of pollution, especially water sources that are close to the acid plant and mine tailings and places of dirt and other sources.

The acidic water can leave calcium ions to the bottom, where underground water exist which increases hardness. One of the water hardness problems, is the increase annul soap consumption, the consumers of soft waterrecent found in years more vulnerable to the disease, of obstructive coronary heart , it is often related to the effect of water hardness on the activity and toxins elements in the water because the water is very soft does not contain enough poison to increase

deaths other than hard water that contains the toxicity of many elements, but has the ability s to stop the activity metals and toxic elements more than soft water[24].

(F) Alkalinity:

Alkaline water is the ability to deal with the acids. The alkaline of moderate water produced by the carbonate and bicarbonate ions. And are reflectedby the concentrations of calcium carbonate equivalents in addition to the equivalents of carbonate ions and expresses and their total is expressed by mg/l of calcium carbonate.

(G) Acidity:

The ability of water interacts with the hydroxide ions. acidity is expressed by mg/ L of hydrogen ions or concentration of equivalents of sulfuric acid or calcium carbonate, acidic source is bicarbonate ions reaction (HCO_3) with hydroxide (OH) ions to form carbonate ions and water, and also not disintegration or partial disintegration of acids such as hydrofloride acid and sulfur acid.

(H) pH:

It reflects the hydrogen ion activity in the water and is expressed by logarithm negative basis (10) of the hydrogen ion in mole per liter, when the PH = 7 the activity that of hydrogenis 10-7 mol / L. This solution is considered neutral. If the PH is less than 7 exhibits. The behavior of the solution in the case of sour PH greater than 7 exhibits behavior of alkaline solution ,and most of the natural water the PH equal 6,8.5. "[12]"

2.1.7Water Chemistry:

Determine the chemical and physical properties of the water determine quality of water and field of use, such as human use, irrigation and industry, cooling and heating properties ....etc.

Water always contain amounts of small dissolved materials, even they lose smell such as solids and gases, so there is no found clear water (H_2O) only. The chemical composition of the solution of the water is a function multiple of factors such as pH and partial pressure of the gas state, and the types of minerals present, and oxidation effort of the solution and microorganisms that contribute to the complexity of the chemical composition of the water "15".

(A)The Living Cycle of the Water:

Evaporated water ascends from the roofs of the sea to the air to rise high into the stratosphere (10-15000 meters above sea level) and water at this height take the best form of drops.The spherical shape, whichis water, one of the special stages called attachment phase in the atmosphere with water, at this moment when gravity begins to loosen its grip on things at exact this rise is drop form the clusters the water molecules .Water dropfinally into the ground after shifting from a cloud to rain, which is the second phase to a life in which the importance of forests show is clearly arises due these forests underground water reservoirs withlarge a high-voltage, exists distant from the other by its extreme proximity to the earth's surface and its purity.

The greatAustrian scientist of Water Affairs ((Victor Shao Berger)) calls this tension the (strength of internal tension) Responsible for many of the natural phenomena associated with water and water comes into contact in its last stagewith

various components and metal salts of the earth due to its transformation into groundwater and rivers and springs .[8]

(B) The Geochemical Cycle of Groundwater:

Effectively affect the hydrological cycle and are summarized in the following:

1-water evaporates from the oceans, seas, rivers, carrying with it small amounts of soluble salts of sodium chloride.

2 - In the hanging atmospherenitrogen compounds dissolved in the water during rainstorms, oxygen and carbon and be acids with concentrations of light.

3 -Carbon dioxide found in agricultural soil dissolved in the water during the movement of water in the soil and groundwater have been to form of the weak carbonic acid.

4 - Weak carbonic formed of carbon dioxide andwater reacts with some rocks such as limestone and gypsum forming calcium bicarbonate and leave with groundwater.

5-The soluble elements, salts and mineralswill melt by the movement of life and deport ions dissolved with water.

6- There are many dissolved geological and biological interactions and in the water to be dissolved solids material stuck in the water and there are also some reduced bacteria in the water, such as sulfur, which form sulfur compounds in the water and move with water .

7-Finally life have moved back to the atmosphere through evaporation, leaving only some of the minerals and salts in the soil and returns to the sea through groundwater or sanitation. (2)

A- Soil Effects on Groundwater Quality:

The metals, salts and clay minerals are moving continuously and the presence of decomposing plants and animals increase these salts (18).

Upon the arrival of the rain into thethis soil move these salts, and reach groundwater through leaching process. And increase the concentration of salts in the water with impact of ion exchange (Ione x change) and other chemical reactions in the soil.

Ion exchange includes the positively charged cations which adsorption happening to it by ions with negative charge on the clay minerals surfaces and this is called the process called absorption, it depends on the proportion of clay minerals and quality in water. (16)

2.1.8 The Properties of Potable Water and Seed Germination:

Drinking water contains specific ratios of salts in small amounts if these ratios exceeds a certain limit becomes unfit for drinking, if intensified salinity people will not benefit from it in drinking or farming .

2.1.9 AquifersEffects:

Water Interacts through its movement to the bottom to get to the underground reservoirs with soil and rocks in the core of the soil-scale (vados zone). and also with the rocks of aquifer these interactions melt is working on some of the solids material through the medium where water passes (19).

Water quality vary according to sources and rocky reservoirs. Underground waters originating from rains be of high quality unless they settle in stagnant places without movement, or found in deposits with rich minerals or in contact with local sourcesor, metals or susceptible to high melting metals such as evaporates. The water in the cracks of igneous rocks and crystalline is of highquality, where the salt concentration is less than 100 mg / L, and this depends on the types of minerals in the rocks. The water hardness could be high water by silicon and magnesium compared to calcium. The aquifers of igneousvolcanic surface it quality of water is also high and has a higher calcium bicarbonate ratio compared with igneous calcium under the surface, and the sedimentary rocks produces water of high quality, for example, water produced from the sandstone rocks contains sodium bicarbonate(13).

The total of dissolved salts in the water represented by the presence of sodium, calcium, magnesium, potassium and chlorine ions and bicarbonate ground water has been classified depending on the concentrations of ions the relation of calcium , sodium and chloride was used and also the of Sodium calcium and the relation were used calcium sodium- chloride and of sodium, calcium ,magnesium ,chlorides and sulfates of water and calcium carbonate and other relationship.This classification is of value to determine the water quality and the types of rocks crisscrossed by groundwater, chemical analysis gives full and good idea of the quality of groundwater and optimum use, and it can be to said that there is a source of sea water sources (magmatic water), a hot water containing lithium, fluoride, silicon dioxide, barium sulfur , carbon dioxide, a little iodine, calcium, magnesium and sodium (22).

Table 2.3: Quality Standards, According to the World Health Organization WHO

Number	Chemical analysis	measruing unit	WHO specifications
1	the color	PT/CO	1-20
2	Smell	Acceptable	Is completely free
3	Turbidity	FTU	0-10
4	pH	pH-value	6.5-8.5
5	Total overall excess salts (TDS)	mg/l	1 – 1000
6	Total hardness	mg/l	100 – 300
7	Chloride	mg/l	200-25
8	Magnesium	mg/l	10-30
9	Calcium	mg/l	200-100
10	Sulfates	mg/l	250-25
11	Silver	mg/l	0.01
12	Nitrates	mg/l	50
13	Nitrites	mg/l	50
14	Iron	mg/l	0.02-0.05
15	Copper	mg/l	3-0.10
16	Cadmium	mg/l	0.005
17	Aluminum	mg/l	0.20-0.05
18	Arsenic	mg/l	0.05
19	Lead	mg/l	0.05
20	Nickel	mg/l	0.05
21	Alkalinity	mg/l	130-200
22	Fluoride	mg/l	0.5-1.50
23	Sodium	mg/l	20-175
24	Phosphate	mg/l	0.4-5

Table 2.4: The Quality Standards in accordance with the Sudanese specifications for drinking water

Number	Chemical analysis	measruing unit	Sudanese Specifications
1	the color	TCU	15
2	Smell	-	Without smell
3	Turbidity	FTU	5
4	pH	pH-value	6.5-8.5
5	Total overall excess salts (TDS)	mg/l	300-1000
6	Total hardness	mg/l	100-170
7	Sulfates	mg/l	250
8	Nitrates	mg/l	50
9	Nitrites	mg/l	2
10	Iron	mg/l	0.1
11	Aluminum	mg/l	0.20
12	Alkalinity	mg/l	190

We find that there is a slight difference between the Sudanese andglobal standards due to the difference in the quality of the rocks and the quality of underground water reservoirs that may contain different metals due to the presence of the mud. (14)

2.1.10 Elements and their Impact on Water Quality:

1 -Calcium:

It is one of the most important basic cations in the groundwater and its source is igneous and metamorphic rocks (feldspar) as the viability of minerals low-soluble minerals. But in the chemical sedimentary rocks containing calcium carbonate and magnesium (Aldlomat and limestone), the groundwater is often soft water.

2 –Magnesium:

Magnesium ions in groundwater produced from igneous rocks and these are the result of metals like Alfrumagnaseyoumsuch as black mica,and it is also found in clay minerals such as (Chlorite) and in sedimentary rocks. Most groundwater producer fromAldlomat rocks containing a small proportion of magnesium.

3 -Sodium:

Produced from feldspar in igneous rocks and other minerals. it also produced by washing soil layers and then filtered water to the bottom, we find water droping contains some concentration of sodium ions. the pollution resulting from the intrusion of sea water and salt water on the far depths of the underground reservoirs increases the sodium ions in groundwater.

4 -Potassium:

It is less present in igneous rocks but spread well in sedimentary rocks and These are non-soluble metals minerals potassium feldsbar, therefore, the concentration of this element is usually little due to the concentration of sodium.

5-Iron:

It is a widespread element in the Earth's crust such as olefin and magnet metals.

Common forms of iron ions in groundwater is a ferrous ions:

Dissolved Fe^{++} and its focus is usually between 1-10 mg / l and when exposed to the atmosphere oxidized and transformed into ions of iron Fe^{+++} which is insoluble and deposited on the Hydoarkisid ferric form, causing turbidity and brown in color of the water. And precipitates and gives rust color for some laundered clothes.

Bacterial activity affect the concentrations of these ions in the groundwater as the steel pipes refineries and packaging in groundwater wells and erosion caused by water containing ferrous ions. We find that the maximum allowable concentration of iron ions in drinking water and domestic use in no more than 0.3mg / l because itsincrease causes the taste of rust, steel pots and others.

6 –Manganese:

Manganese is found in minerals such as Biotite and manganese oxides andmanganeseHidoroxad.their origin of soil and some sedimentary rocks. MN^{++} manganese ions in the water recharges less active and soluble from ferrous ions so the concentration in the groundwater is less.

It must not exceed the concentration of manganese ions in the water 0.05mg / l.

7- **Aluminum:**

it is considered the third element in proliferation of the ground crust ingredients, but groundwater contains small traces (about 0.5mg / l) of aluminum ions and be dissolved when the PH> 4.

8- Carbonates and Bicarbonates:

We find that the source of the carbonate and bicarbonate of atmospheric carbon dioxide and the activity of soil organisms and the activity of sulfur-reducing bacteria. And also from the melting of the constituent limestone calcium carbonate and bicarbonate concentration, we find that it becomes more than 200mg/l when the carbon dioxide in the presence of underground water feeding the water tanks.

9-Chloride:

One of the sources of chloride in groundwater is halite metal and sea water after production of igneous rocks of chloride, and, is very low. If the groundwater in contact with sea water they can contain amounts of chlorides and sodium.

The limit permitted for groundwater to containchlorides in drinking water is about 250 mg / l as chlorides affect the taste of drinking water

10-Sulfate:

Sulfates are formed of oxidation of other sulfates found in igneous sedimentary rocks such as gypsum and sodium sulfate and concentration allowed in drinking water should not exceed 250mg / l, where the taste of the water be bitter, and when the concentration is high, it works as a laxative and purgative for the stomach.

11-Silica:

Silicon is the second element in terms of its spread after the oxygen in the Earth's crust and is concentrated, groundwater in volcanic rock and sandstone, and concentration allowed in drinking water 20mg / l

12-Fluoride:

Its source is the solution offluoride metal, calcium and fluorite in igneous rocks and is produced in the sedimentary rocks of feldspar.

And the concentration of fluoride in the groundwater is up from 1 to 30mg / l and height of it concentration in drinking water have a benefit to the teeth, where the teeth are resistant to erosion if increased concentration focus by high percentage it causes the staining of teeth.

13 -Phosphorus:

The minerals rich in phosphorusare Alapattencharacterized a very low rate of melting in the groundwater is less than 0.1mg / l

14- Boron:

It is found in the boric acid and must be more than its concentration in drinking water than 0.5mg / l

15- Nitrogen:

Most of the nitrogen in the groundwater comes from the atmosphere, where nitrogen molecules turn into organic materials, by nitrogen bacteria, (Rhizobium species) that live interdependent with some plants such beans.

The nitrogen in the atmosphere turns into ammonia salts by soil bacteria, which in turn transformed by aerobic bacteria and bacteria of nitrogen into nitrates

Some organisms have the ability to convert atmospheric nitrogen bybiological way to nitrates, such as (Azoto bacterial) blue-green algae, which often live in the water.

High amounts of nitrogen can be found in low places where the remains of animals such as birds and colonies of nests of animals and bats in caves accumulate and decompose [21]. Groundwater can also contaminate nitrogen through human activities such as agriculture, industry, and other waste.

The nitrogen nitrate concentration ranges in groundwater between 1 to 50 mg / l and up to 100mg / l. The maximum allowed for human use of nitrogen 10mg / l.

the high rates of nitrates in groundwater cause deaths baby's least four months and two there are called (blue baby disease).

When adults drink container water of high concentrations of nitrates, since the Number of pH is low for the stomach because it is acidic and is a tonic for the bacteria nitrates reducing, the nitrates produces imines nitrous in the stomach and this is known as stomach carcinogens, which causes a higher incidence of stomach cancer in people who drink water containing high concentrations of nitrates, ammonia nitrogen is therefore undesirable in drinking water it concentration must be less than its focus 50mg / L.

2.1.11 Impact (Trace Element):

The elements are most of with different concentrations in groundwater. The knowledge of the elements of impact on groundwater is very important to determine the field of use, for example, Arsenic should not concentrate than more (0.1mg / l) in drinking water. Barium also affects the heart and blood vessels and cadmium is causing nervous tension and deposited in both the liver and kidneys so the maximum concentration permitted is 0.01 mg / l and copper significant impact of the operation of vital blood component but if you focus on the limit of 0.1mg / l increased cause liver damage, and the lead of the toxic elements which cause brain tissue damage to the children and the mentally retarded, and this element was and

still is made from pots, water pipes, that the latest recommendations of the United States environmental Protection agency in 1995, is not use of lead in the industry using water and concentration limit for lead in drinking water is 0.05mg / l Mercury is highly toxic elements and its concentration should not exceed about 0.002mg / l. [23]

2.1.12 Radioactive Materials:

The cause of the radioactivity in the ground water is the presence of radioactive elements such as uranium (238) and Thorium (232) also the least active elements such as potassium (40) and Rubidium (87).

The second source of radionuclides in groundwater and is the atmosphere by cosmic radiation and electromagnetic waves that collide with gases such as nitrogen (41) and oxygen (16) and carbon (14) which is used in the history of water life.

The third source of radioactivity of groundwater is the radioactive contamination caused by radioactive waste and nuclear explosions, such as Strontium leak (90) and Cesium (137) with atomic dust explosion.

Aquifers contaminated by radioactive waste when it is made up of sandy coarse-grained stone or limestone. These groundwater reservoirs are directly exposed to the atmosphere.

(Active volcanic places) should not exceed the concentration of uranium in the water to 0.0001 -0.001mg / l. [17]

2.1.13 The water Contaminants:

(A) Introduction to Contaminates:

This small percentage of fresh drinking water is distributed according to the distribution of population density, it would cover the needs of humans, but in reality there is no such justice in thedistribution of natural resources in general, for example, we find rain in regions such as the tropics up to about several meters while desert areas exists.This lack of balance is clearly shown in the Amazon basin, which accounts for 20 percent of the drinking water in the ground while it has a very small percentage of the world's population, and even within the continent itself there is a large discrepancy between the amount of rainfall and population density and in general, rainfall intensity concentrated on the flat areas, which are usually suitable for habitation and agriculture get a small percentage of the rain and the best example of this is Britain, where the low populatedScottish Highlands rainfall reaches ratio by nearly three meters per year and the population density of only two people per square kilometer while inSoutheast regions of Britain with a population density of 500 people per square meter, is precipitation is lower than 0.6 meters ,per year and the proportion ,and here we note that even at the local or regional level that there is a significant difference in the distribution of water and its availability to the population.(6)

(B) Water pollutants:

Water pollutants varywith variation of sources of pollution and the different nature of sources generating pollution.Scientists have identified main types of water pollutants as the following types:

1-Waste and pollutants biologically decomposed.

2-Heat and thermal pollution.

3-Pathogens.

4-Sediments.

5-Chemical contaminants.

6-Radioactive waste (radioactive contamination) [25]

2.1.14 Types of Water Pollution:

Water pollution can be divided into three main sections, according to the quality of water pollution and according to the quality of contaminants. Contamination is classified into the following types:

1 -Physical pollution:

It means pollution by factors and physical elements which are contaminants of water, and change the physical properties andspecifications, of waterproof standard by changing the temperature or salinity or increasing the hanging material with materials, whether of an organic or inorganic.

Whenthe most physical forms of pollution, are thermal pollution and solid waste pollution and radioactive contamination.

2-Chemical pollution:

This pollution is often man-made. The chemical industrial components are vehicles the most important reasons for this pollution. The chemical materials are used widely in homes, such as detergents, solvents, dyes, pesticides, oils, cars, etc. These materials may find their way into sewers and then into the water bodies

leads to its contamination and to determine the danger of this material is sufficient to say that one gallon of motor oil can pollute a huge volume of water.

Chemical pollutionAlso result from specific sources of industrial actions in the transport incidents, and it has come from unlimited sources such as sewage in urban and rural areas and move the atmosphere in the works road surfaces.

Parking areas collect toxic substances such as lead, cadmium and these materials are washed into streams and rivers during rain seasons and make long-term toxic effects due to their accumulation in living organisms [23].

3. Biological pollution:

The result from the changed of biological properties and changing of water standard specifications, is consider the most dangerous kind of pollutants among the types of environmental pollutants because it is related to diseases caused by biological factors, and these pollutants produce are mostly produced by the mixing of human and animal waste with water directly by mixing with sanitary water and agricultural water and lead to infection with many diseases, so you should not use this water for the washing and drinking unless after exposure to various sterilizers and disinfectants, such as chlorine and filtration by mechanical filters.[11]

2.1.15 Bacteria and viruses:

Groundwater, including shallow aquifers is supposed by free of any bacteria or viruses. The presence of any bacteria and viruses is an indication of the presence of sources of pollution. But this does not negate the existence of other types of unsatisfactory bacteria and viruses in the water.

The best way to study microbial activity in deep aquifers is to take un suspicious (Coring). Rock samples. The source of the bacteria in underground reservoirs resulted from leakage of minute organism in sedimentary rocks during its inception and can be migrated with cold water from the air and other circles. groundwater can become contaminated by surface water containing sewage and garbage and wash the soil, and contaminated water in general, and the limit of drinking water for bacteria (Caliform) is four colonies only per 100ml whereas inorganic bacteria that live on the human colon (facalcale forms) is colony per 100ml, depending of reports of the US environmental Protection agency (US EPA1975).

2.2 Treatment of Drinking Water:

The best method of water treatment is the physical way, but the world is interested in water-chemically, and we are talking here about the drinking water due to its importance for human health and for his life, knowing that wastewater treatment in these days enjoys importance for its relationship with the protection of the environment and humans from contaminated water of factories and farms, and we receive drinking water today after passing through the filters and chemicals are added to in order to clean it to get ride of impurities and microbes. filters are used mainly for catching organic organism, and harmful and hanging minerals, while chlorine is used in compliance with the instructions of the sterilization of germs, parasites. These materials are usedin a lot, even in clean water as a procedure. Other substances also used to kill germs drinking water, including the use of ozone, and ultraviolet (used both to kill the algae, and the method of ionization) I nAddition to calcium to reduce the sodium ions in the water, and the and this method aim at purifying water according and these specifications may vary from state to state, but there is a modern way to improve the physical health status of

drinking water by spilling it in the pipe in large quantities. The truth is that the best method of water treatment is physical way, but the water treated in this way is a rare coin in the market, which isa way dealing with large quantities of water and maintains its effectiveness [24].

2.2.1Water Treatment Cleansing:

The tiny micro-size of organisms means that the full removal through the methods of coagulation and filtration, is process not be fully guaranteed, and we can find , in some cases, a lot of groundwater not in need for treatment (virtual point) but that does not negate the possibility of existence of bacteria and viruses. Where the drinking water has changed with the change of scientific methods and techniques for the screening and selection of water with emphasis on the observance of the rules of public health

So it was necessary to make sure to remove all living organisms that cause disease from drinking water using appropriate cleansing process.

The drainage that comes from public uses in homes, hotels and familiar workplaces, and even many industrial wastewater contain large numbers of organisms, and that the traditional processes for water treatment is not expected to eliminate all the organisms that cause disease despite the lowness of their number after a clear and effective treatment, and when are unloading the treated water in water basins or used for irrigation purposes, it is necessary to destroy all pathogenic organisms, as well as objects that are working on human pollution, and in fact the full purification wastewater may be undesirable because removal of most organisms will hamper self-technical operations in future water, but that the remains of disinfectants can to cause damage to organism and aquatic life in general, it is very important to distinguish between cleansing which means the

killing of microorganisms which cause infection, with diseases and the sterilization which means kill all the microorganisms and the usual drinking water, water disinfection for medical uses, or pharmaceutical uses.

It is usual describethe number, which is killed from microorganisms in the form of a percentage, and the murder rate depends on the type of disinfectant material used, and this depend on the temperature and pH and other environmental factors.Chlorine gas and is one of the most important elements used in water purification, and We find it determining the degree of disinfection uses, this is done through the use of high doses of purified material with a short period of time, or is used as a low dose for a long period of time.

(A) Chlorine and its Compounds:

chlorine is uses (and its compounds) in large-scale for water purification, due to the following aspects:

1-Easy to get it in the form of gas, or liquid, or solid material.

2-Gas is cheap.

3-Easy to use as a result of the speed of the high solubility (7000 mg / L).

4-Leaves residue in the solution not considered harmful to Human, this means it gives protection in the distribution system.

5-It is highly toxic for most microorganisms, which means it stop all metabolic activities.

Althoughthe previous characteristics of but that the gas as a poisonous gas (Gorge to humans) requires carefulness, when consumed and traded , it can also causes problems relating to the existence of taste in drinking water. This problem

is becoming increasingly apparent in the case of the presence of phenols in the water, and chlorine isconsidered one of the strong oxidizing agents, which will be determinedby the quickness of reduced agent with the unsaturated organic compounds, the following reaction is an example for this:

That this vital rapid demand for chlorine must be consistent with its requirements before chlorine becomes available to the process of cleansing, we find that one mg / l of chlorine can oxidize 2 mg liter of BOD but that is not of means necessary for the treatment of wastewater.

after the retention chlorine the following reaction occurs:

1-In the absence of ammonia

$$HCl + HClO \rightarrow Cl_2 + H_2O \qquad (2.7)$$

The HCLO acid is considered one of the most efficiently cleared factors, taking into account the chlorite ion CLO- which relatively ineffective. HCLO acid is decomposed the hydrogen concentration is related as when PH of 5.7 and all when pH = 9 and therefore the most effective cleansing occurs when the PH levels is acidity [(2).]

2- In the Case of Ammonia:

$$NH_4 + HCLO \rightarrow Cl_2 + H_2O \qquad (2.8)$$

$$NH_2CL + HCL \rightarrow NHCL_2 + H_2O \text{ (residues linked)} \qquad (2.9)$$

$$NHCL_2 + HCLO \rightarrow NHCL_3 + H_2O \qquad (2.10)$$

Third Nitrogen chloride

The united and associated residues are sturdier than the free remains, but they are less efficient in terms of their work as an antiseptic, and when studying the effect of the killing of these component we will see that the remains associated need a time of 100 times the amount neededby the free remain in terms of concentrate free residues,so give inInteractively we find that the private time from residues associated with have a 25 times that give the degree desiredAmmonia can also add to the water, which tend to cause the difficulties of the in terms of the making taste in water or show unacceptable odors and, in the case of the presence of Ammonia, we find that chlorinationgivesresidues curve distinction. Once the reaction of Ammonia together for more chlorine residues associated with the free remnants at breaking point.

In theory, the refraction exist at 2 part of CL_2 and one part of the ammonia NH_3. from the scientific point of view, we find that the ratio is 1:10 and before reaching the breaking point, the free residue commensurate with the dose used, and in the event of problems related to the emergence of taste or smell in the water , this can be overcomes by destroying the taste or smell through the use of the action oxidized chlorine dissolved, a process known as the over-saturation or super chlorination, and can be removed By sulfur dioxide after the expiration of the required contact [15].

$$HCL_3 + CL_2 + H_2O \rightarrow HCO + NH_4^+ \quad (2.11)$$

$$CL_2 + SO_2 \rightarrow H_2\,SO_4 + HCL \quad (2.12)$$

Attention have been drawn in recent years toward the existence of a simple concentrations of organic compounds vancomycin in the water, some of which is considered one of the causes of cancer when their presence is relatively high concentrations in animals, and so there may be risk in health during the period

consuming drinking water with simple concentrations of these combinations. Organic materials chlorinated and considered, including the Tri Halomthanat such as chloroform of more species, as can be seen when the raw water containing organic materials, such as those coming from the sewage flows examination, can be disinfected with chlorine, and so far there is no scientific evidence that existing levels currently pose a health risk in any way, but we must work to prevent their composition with control and vigilance while avoiding the use of chlorine without any damage and caveats facing the chlorine as well, the health risks resulting from the likelihood of a gas leak from the treatment plants or through the process of the transfer cylinders Gas .

The idea of possibility of generation Gas by electrolysis of water and reduce those risks, for small stations, thus emerged .We find that the use of hypochlorite solution is consider safe away of chlorination from in spite of what have been said ,There were noaccidents have been recorded for these risks in the water treatment plants, it uses chlorine dioxide to control of the taste and odor of water.

Although there is evidence that this material is considered much stronger than chlorine disinfection in alkaline , but it is more expensive than it in price as it does not combine with Ammonia.Chlorine dioxide can used to get the remnants of free chlorine in the water that contains great volumes of ammonia which is consider undesirable because of the nutritional value that encourage the growth of bacteria, and the substance chlorine dioxide is not fixed material, and must be generated and processed in water treatment station by chlorine reaction and its impact or with the reaction of acid with sodium chlorite station [18]

$$5\text{Na CLO}_2 + 4\text{HCL} \rightarrow 4\text{CLO}_2 + 5\text{Na CL} + \text{H}_2\text{O} \qquad (2.13)$$

(B) Drinking Water Treatment WithOzone:

Man started to know Ozone from a long time in a wonderful way. long age redskins fishermen the native population of north America) pre- Columbus that the fishing is plentiful in the nights that comes after thunderstorms where the air is saturated with the smell that does not smell like the usual iodine but like fresh hay harvesting, is the same note of the ancient Greeks in the nineteenth century ancient scholars did not know the name of ozone , it is believed that the electrical charge from the lightning accompanying the under storms lead to the increasing of the proportion of Oxygen surface layers of the Sea water , and from union of Oxygen atoms ozone 0.3 is formed . Its concentration increases in the surface lagers of water a matter which attracts fish to the surface and thus fall in the fisherman net.

In the month of April 1774, the English chemist Joseph bresteli (1773-1804) discovered a colorless gas that helps in ignition and leads to the Oxidation of elements .The great French scientist Avozabah (1734 -1794) gave it its find Name (Oxygen) in 1779, that is after the previous date by five years . In 1785 the chemist Martinus Noticed the distinctive odor of Ozone Gas when he focuses electrical charges on oxygen gas, and in the nineteenth century, particularly in 1840, the chemist Christian Ferdishpin, while working in the Swiss Bazel Labs, by repeating experiments, he found that the cause of the previous odor is the formation of a new gas resulting from the union of oxygen atoms together. He caused this gas the name we know now (Ozone).

Ozone in nature is a pale blue gaze constituting a cover that surround the earth on a height that ranges between 50- 100 thousand feet, it is formed from the union of oxygen atoms. The thickness of Ozone of every emitted from the Sun –

during the day periods, the thickness of this layer increases from the dark side of earth. In the long dark winter which covers the two poles of the earth globe north and south, this layer is completely disappear because ozone is heavier than the air we breathe. When Ozone descending from the atmosphere meets water vapor it is transformed into another substance called hydrogen peroxide which falls with rains giving the refreshing odor that comes after the rain. This substance itself, which gives the plants that depend on rain water a better growing than those depending on river water.

Ozone has a strong disinfectant power, and also has an enormous power for oxidizing elements and thus it kills bacteria and viruses and removes many toxins. In fact, the strength of ozone disinfection is strong by about 300 times of the ability of chlorine disinfection and sterilization. Thus , it can treat fine particles which give water unacceptable taste and load smell , so the ozone is used in the purification of drinking water in the French , Monaco in 1860 , but the German Vasdin has preceded all and installed the first great station to purify drinking water using ozone in 1901 and followed by many European cities such Zurich, Brucsls , Paris , Marseille , and Masco which has the largest plant to purify water using ozone . Currently, there are more than 2.500 plant of this kind distributed around the worlds. Since 1950 the purification of water pools is by the use ozone, the summer Olympic games which took place in Los Angeles in 1984 witnessed a threat from the European swimming teams if the water of swimming pools is not purified from ozone but not chlorine.

Ozone is composed of three Oxygen atoms, it's melance weight is 48 and its density equals three time that of Oxygen and it is a strong oxidizing agent surpassed only by fluorine. This power for vital oxidization is scientific bases for the use of ozone in purification and sterilization. It is obtained by passing the dry

oxygen or aim through electrical discharge ranging between (6000- 20000) volt and between (50- 500) H_2. It is considered an unstable gas with high toxicity with blue colors with the existence of a strong odor and the smell of hay or newly harassed grass.

It is considered one of the strong oxidizing gases. It is also considered a powerful purifying substance. It is useful in removing the colors and odors. It is like Oxygen, that is of low solubility in water and it is because of having non – static form it does not leave any residues upon decomposition [9].

treatment by ozone is considered expensive except in the presence of cheap sources of energy, but it is characterized by high good power for colors. In some case filtration with the use of ozone can give good treatment for water just like what we obtain from the complication means and techniques such as the use of coagulation, sedimentation, filtration and chlorine in the treatment plants.

Due to the absence of the remnants of ozone in system of distribution we find that bacterial growth and what accompanied of unacceptable smells and unpleasant taste can happen , but such growth can be prevented by adding chlorine after ozone reacting .

Ozone reaction has some applications in the oxidization of some types of sewage and industrial water which do not fully respond to the process of biological oxidation Ozone gas has to be generated in treatment site by passing dry air during electrical discharged with high voltage differential provided that the used frequency should be high . These are two types of ozone generators, the tin types having flat electrodes and glass insulates and the tubular type provided with cylindrical electrodes with circumscrihed axes in which there are cylindrical glass

in insulates. The low tension is cooled with water and air passes between electrader where it has tension due to the electrical discharge on the air gab [10]

The rate of ozone production reached about 4% in weight from the total weight of the passing air with every needs reaching 25 kilo Walt /kg from the produced ozone. Ozone reacts with organic substances to give organic component under special circumstances. The reason for the presence of these compounds in water is not understood yet.

(C) Treatment of Drinking Water U V:

There are many rays which are considered as purifying agents, but the ways of ultra violet radiation are the most commonly used in small treatment plants. We can benefit from the purifying action of ultra violet rays at a wavelength reaching 254 non – meters. This length is considered quite strong, provided that microorganisms shall be exposed to this radiation on. Therefore we have to make sure of absence of turbidity in water with increasing the dose to ensure the absorption of organic material to this ray.

It is present in the water current. The water required to be purified by rays shall be passes through two pipes for discharging electricity through the Mercury and reinforced reflective metal popes which give the sufficient purification with duration and preservation time of few seconds. In spite of the needs and necessities of strong energy which range between 10- 20 and 0.1 cm^3 for each speed. The use of ultra violet rays as a source of purification has many advantages such as. there is no danger from overdoses, whereas the defects of usage are non – existence of remains of rays, high cost, the importance of availability of water in a clear and transparent turbidity in it.

2.2.2Other Types of Disinfectants:

There are many other methods used in water purification in during the following:

1-Heat:

Heat purification with the use of heat is considered one of the efficient process but it is costly solution. It also weakens and reduces the acceptable taste of water through the removal of Oxygen dissolved in water, also its impact leaves no residue.

2-Silver:

The Roman used collided silver in order to maintain the quality of water instorage containers at concentrations up to 0.5 mg/1. Silver is considered toxic for most micro-organism. It is of high value in small portable filtration units for use in sites for it can remove turbidity and initiate purification. It is costly therefore it is only suitable for small use

3- Bromine:

The halogen elements such chlorine and it has antiseptic properties of water and can sometimes be used in swimming pool where the resultant residues make inflammation in the eye, with determining the total number of bacteria in one cm of water as well as determining the presence of (Eshareichia Coli) with coolly index or coollyterrre indicator for water after purification. indenture Bacillus bacteria is considered not harmful in itself but the processes of its specification is used as an indicator for bacteria pollution in water. The use of such Bacillus is taken as an evidence for the presence of micro – Organism in water attributed to the following Scenarios:

1. The determination of the presence of intestinal bacilli E. Coll to in water is simpler that the determination of the presence of other intestinal bacteria.
2. Strong oxidizer used to purify water affect these bacilli hardly more than it affect on micro organism causing intestinal diseases.
3. This bacillus bacteria is found in the human gut and intestines of worm blooded animal , so their presence in the sources of water supply is an evidence of contamination of water these resources by fecal wastes(7)

E. Water purification Methods:

Can be categorized as follows:

1.Thermal Methods:

Such as boiling water for 12-20 minutes which leads to the killing of all the non- micro balical formulations. Germs are killed by improving water under pressure at the temperature of 120^{c} and be left for two hours to allow the spread of bacteria. It is then heated again until boiling despite the simplicity of this but its use is limited because is cannot be relied on as a basic method for the purification of large volume of water.

2.Physical Methods:

purification processes in these methods are conducted for the use of the impact of Sun or ultra violet rays or gamma rays or the use of ultrasound surface.

3. The impact of the use of some heavy metals Ions:

The use of non – significant a mounts of ions of silver copper and Gold lead to water purification, but this requires long exposure periods. We find, for example hat water purified from pathogenic organisms by the use of silver ions with high concentration 0.015 mg needs a contact

And it is often activated carbon impregnating these ions in order to be used in the cleansing process, particularly in the powerful hardware or medium-sized.

4-use filtration through different porous media:

Most of Pathogens except for viruses with the largest dimensions of 1-2 microns; therefore the nomination through the circles of the nomination pores be less than 1 micron water will save them; and most types of filters used in this field are filters made of ceramic porous or porcelain Chinese or membrane filters.

5. Use Strong Oxidizers:

This is the way of the most common ways to use, and oxidizers used for this purpose: the various chlorine and its compounds, bromine, iodine, potassium permanganate, hydrogen peroxide.

Selection is based disinfection method to a lot of factors relating to the conduct and quality of water to be addressed and the degree of initial purification of the water, and roads and transport pressure and Disinfectants insurance, and the possibility of the completion of the disinfection process and more methods used practically in the water disinfection technology are methods using oxidizers and organic conducting water purification process strong oxidants generally a two-stage reactor cleansing the first phase and then spread to the inside of microorganisms and the second stage to enter into interaction with the enzymes inside the cell is determined by the speed of the disinfection process dynamic deployment of the reactor cleansing, in the body, and death actual living cell micro-induced oxidation enzymes reactor cleansing, rise cleansing process speed, while increasing the concentration of reactors cleansing in the water, raise the water temperature, turn cleansing in water reactors into formats is widely dispersed

owns the fastest through the cell membranes of the spread of the ions formed during the breakup of these materials.

And slow water purification presence of organic material capable of oxidation process speed, as well as the presence of various reviews in materials colloidal and suspended matter, impede colloidal material and suspended solids during their presence in the waters of contactless bacteria with reactors cleansing with attract to these bacteria, noted that the process of raising the water temperature 0.2 cent great to 10 percentage accelerate the process of cleansing severely, while lifting the following seems even less influence of heat as the water temperature is greater than the mechanical chlorination and free chlorine affect

Chapter Three

Methodology

Chapter Three

Methodology

3.1 Introduction:

We discussed in this section practical part of the research,which includes analysis of samples to multiple devices .

3.2 The study area:

1-Arquette area--the state of south Khartoum

station (69)

contractions water rate:

At maximum=100%

In normal day=60%

Elevation (height of the well) =384 m

2-Alssahafuh area –the state of south Khartoum

Station (7)

Contractions water rate:

At maximum=100%

In normal day=60%

Elevation (height of the well)=384m

3-Jabrah area—the state of south khartoum

Taha al-mahi station

Contractions water rate:

At maximum ==100%

In normal day==60%

Elevation (height of the well)=384m

4-African university—the state of south Khartoum

Tap water faculty of science at the university of Africa

3.3 Methods of Taking and Processing of Samples:

1-Using sterile glass bottles and conducted by the following tests:

A-Chemical tests

B-Physical tests

C-Biochemical tests

3.4-Chemical Tests:

1-Purpose:

Analysis of a group of chemical elements in the water by Spectrophotometer, Palintest Photometer, Flamephotometer, Atomic absorption and Titration

2-**Materials**:

Aluminum No (1) tablet- Aluminum No(2) tablet-Eriochrome cyanine indicator-Nitratest tablet(zinc-based powder)- Nitricol tablet-Sodium chloride solution-Hydrogen gas-sodium free-Oxygen gas-Hydrochloric Acid(concentrated)-

Manganese solution, stock-Manganese solution, standard-Nitric acid-Ammonia No (1) tablets-Ammonia (2) tablets-Hydrogen peroxide30%-Phenolphthalin indicator solution(10g/L)-Potassium chromate indicator solution-Silver nitrate-Sodium chloride-Sodium hydroxide solution-Sulfuric acid-Fluoride No(1),(2) tablets-Distilled water-4 Samples-phosphate No(1,2) tablet

3-Apparatus:

A-Volumetric flask (50-250) ml

B-Measuring cylinder

C-Test Tubes

D-Burette

E-Cell 10ml

4-Machines:

Spectrophotometer-palintest photometer-Flame photometer-Atomic Absorption photometer.

5-Methods:

1-Aluminium:

A- A test tube should be Filled with sample to the 10 ml Mark

B-One Aluminium No1 tablet should be Added, crushed, and mixed to be dissolved

C-One Aluminium No2 tablet should be Added, crushed and mixed gently to be dissolved. Avoid vigorous agitation

D-We stood for five minutes to allow full colour development

E-photometer instructions should be seen.

F-The result is displayed as mg/l Al

2- Nitrate:

A-Nitratest tube should be Filled with sample to the 20 ml Mark

B-We Added one level spoonful of Nitratest powder and one Nitratest tablet. And did not crushed the tablet. Screw cap should be replaced and shaken tube well for one minute.

C-Tube should beAllowed to stand for about one minute then gently inverted three or four times to aid flocculation. Allow tube to stand for two minutes or longer to ensure complete settlement.

D-Screw cap should be removed and wiped around the top of the tube with a clean tissue.

The clear solution should be carefully decanted in to around test tube, filling to the 10 ml Mark.

E-One Nitricol tablet should be Added, crushed and mixed to be dissolved.

F-10 minutes should be stood to allow full colourdevelopment.

G-Phot 23 on photometer should be selected for result as mg/l N

H-Photometer instruction should be seen.

3- Ammonia:

A-Test tube should be Filled with sample to the 10ml Mark.

B-Ammonia No1 tablet should be Added and one Ammonia No 2 tablet should be crushed and mixed to be dissolved.

C- I stood for 10 minutes to allow colour development

D-I Selected phot 4 on photometer to measure Ammonium mg/l N

E-I saw photometer instruction.

4- **Sodium**:

This test method covers the continuous measurement of Sodium in water using flame photometry

5-Manganese:

Manganese is determined by atomic absorption spectro photometry

6-Fluoride:

A-Test tube should be filled with sample to the 10 ml Mark.

B-One Fluoride No1 tablet should be Added, crushed and mixed to be dissolved

C-Fluoride No 2 tablet one should be Added, crushed and mixed to be dissolved

D. I stood for 5 minutes to allow full colour development

E- I selected phot 14 on photometer.

F-I saw photometer instructions and the result is displayed as mg/l

7- Chloride:

A- I Poured 50 ml of the sample, containing not more than 20 nor less than 0.25mg.

Of chloride ion, in to a white porcelain container. If Sulfite ions are present, added 0.5 ml of hydrogen peroxide to the sample, mix, and let stand for 1 min. diluted to approximately 50 ml with water, if necessary. Adjusted the pH to the phenolphthalein end point (pH8.3), using HSO_4

B-Added approximately 1.0 ml of KSO_4 indicator solution and mixed. Added standard $AgNO_3$ solution dropwise from a 25ml buret until the brick-red color persisted throughout the sample when illuminated with a yellow light or viewed with yellow goggles.

8- Phosphate:

A-Test tube should be sampled andFilled to the 10 ml Mark.

B-One phosphate No1tablet should be Added, crushed and mixed to be dissolved.

C-One phosphate No2 tablet should be Added, crushed and mixed to be dissolved.

D- I stood for 10 minutes to allow full color development

E-I selected phot 28 on photometer for result as mg/l

F- I saw photometer instructions

3.5-Physical tests:

1-Purpose:

Conductivity, TDS, TSS, Turbidity, T.Hardness, T.Alkalinity and pH should be measured .

2-Materials:

4 samples-distilled water-Buffer solution (4,7,10)-EDTA

3-Apparatus:

A-Volumetric flask 250ml

B-Test tubes

C-Buckner funnel

D-Filter Paper

4-**Machines**:

Conductivity Meter-PH Meter- photometer

5-Methods:

1-Turbidity:

A-A portion of the sample should be filtered through a GF/B filter paper

B-A test tube with filtered sample should be Filled and retained for use as the blank tube.

C-A test tube should be Filled with unfiltered sample to the 10ml Mark

D- I selected phot 48 on photometer

E-Is saw photometer instructions

2- Alkalinity:

A-test tube should be Filled with sample to the 10ml Mark

B-One Alkaphot tablet should be Added, crushed and mixed until all of the particles have dissolved

C-I stood for one minute then remixed.

D-I selected phot 2 on photometer

E-I saw photometer instruction

F-the result is displayed as mg/l

3-**Hardness**:

A-50 ml of clear sample should be measured in to an opaque white container or a clear colorless container utilizing a white back ground. Adjusted the pH of the sample to 7 to 10 by adding NHOH solution. Added 0.5 ml of buffer solution, and approximately 0.2g of hardness indicator powder. Added standard NaH EDTA

solution slowly from a burette with continuous stirring until the color changed from red to blue

4-Conductivity:

This test method utilized dip-type or pipet type conductivity cells for testing static samples having conductivities greater than 10m S/cm .Temperature controlled and correction methods are also provided.

5-TDS:

The same device used (Conductivity meter)

6-TSS:

A-A filter membrane should be put in the oven and allow to dry for 10 minutes

B-A desiccator should be but in and allow to cool for 10 minutes

C- I weighted the filter membrane and recorded the weight as W

D-Buckhnerfunnel should be Placed on, the cup and tighten using the tightener provided

E-I took a volume of liquid to give a suspended matter of 0.1 g and put it in to the cup

F-Is started the vacuum pump

G-When all water is filtered, I stopped the pumping, removed the filter membrane cautiously using the forces and allowed it to dry in the oven for 10 minutes

H-When dried, I allowed it to cool in a dessicator and reweigh

I. I recorded the weight as W

7-**PH:**

The pH meter and associated electrodes are standardized against two reference buffer solution that closely bracket the anticipated samplwpH. The sample measurement is made under strictly controlled conditions and prescribed techniques

3.6-Biochemical Tests:

1-**Purpose**:

I Measured BOD test.

2-Materials:

Potassium Hydroxide – 4 Samples

3-Apparatus:

Bottles (Dark)

Stirring base

4-Machines:

Incubator

5-Method:

BOD:

A- I poured into bottles the volume of samples according to a doptad scale, measured by a graduated cylinder

B- I put in to each bottle a magnetic stirring bar

C- I Filled the alkali holder, in small container located under bottle cap, with an amount of carbon dioxide absorber, enough to avoid losses through the holes. if some alkali falls into a bottle, wash thoroughly before pouring again a volume of sample under examination

D- I placed the bottles into position in the stirring equipment

E- I Introduced the stirring equipment in to the refrigerated thermostat set to the temperature chosen for incubation. I Connected magnetic stirrers to mains introducing the plug in to the socket. I Put into operation the refrigerated thermostat

F-After 40 minutes the apparatus and samples are usually in thermal equilibrium at the closen temperature

G-The apparatus is ready to start BOD measurement. I Placed a BOD sensor on each bottle and screwed tight. Reset each BOD sensor cancelling any memorized value. I choose the most appropriate scale and started the measuring cycle.

Chapter Four

Results and Discussions

Chapter Four

Results and Discussions

4.1 Introduction:

In this section we will talk about the results of analyze of samples in various tests and discussion.

4.2 Analysis of samples:

TABLE 4.1: Analysis of Samples

TEST	UNIT	Arquette area (69)	Alssahafuh area (7)	Jabbrah area	Africa University
AL^{+++}	PPm	ND	ND	ND	ND
NO_3^-	PPm	3.30	3.20	5.11	3.13
NH_3	PPm	ND	ND	ND	ND
Na^+	PPm	8.68	16.50	40.91	18.75
Mn^{++}	PPm	0.00	0.00	0.00	0.00
F^-	PPm	0.216	0.180	0.410	0.321
Cl^-	PPm	35.45	70.91	97.51	92.18

Table 4.1: Continued

PO_4^{-3}	PPm	13.40	12.20	20.13	15.71
Turbidity	NTU	0.00	0.00	0.00	0.00
T.Alkalinity	PPm	200	90	350	95
T.Hardness	PPm	160.120	70.304	357.102	79.501
Conductivity	ms	234	158	751	199
TDS	PPm	140	88	1993	90
TSS	PPm	4	0.00	3	8
PH	pH-Value	7.09	7.00	7.70	7.64
BOD	ppm	38.9	1	3	2.6

4.3 DISCUSSIONS:

1- from the chemical point of view World Health Organization has developed WHO limits on the concentration of the components, where should these concentrations do not exceed the permissible limits because they cause health risks after exposure to long periods of time according to our analysis of the samples (Arkwait, Alssahafa, Japrah and the University of Africa), we find that the concentrations of all of (aluminum and nitrate and ammonia, sodium, Almanganese, fluoride, chloride and phosphate) and turbidity and pH within the limit according to The World Health Organization and the Sudanese Specifications in table (2.3.) and (2.4).

2- results of the analysis indicated in Table (4.1) that the Alkalinity of the drinking water, which is the ability of water to resist the change in the pH, in Arkwait were within normal levels but the water in Alssahafa and Africa University, which dropped they to below natural levels, according to the World Health Organization and Sudanese specification standards in table (2.3) and (2.4) the water in Japrah increased in Alkalinity , whereas the main source of Alkalinity is carbonate and bicarbonate salts hydroxide compounds, there is a relationship between the Alkalinity and total hardness in terms of calcium carbonate. We find that the increased & decreased alkaline lead to diseases including: Change in blood pressure, gout disease and joint pain because the alkali metals expelled acidic toxic waste from the body.

3-total hardness which is the ability of water to precipitate soap or is the concentration of calcium and magnesium in the water. The results of the analysis of Table (4.1) that the hardness terms of calcium carbonate was part of the minimum international standards for Arkwait, Alsahafa and the University of

Africa decreased to below normal levels from the standards of the World Health Organization and Sudanese specifications in Table (2.3) and (2.4), in Japrah where hardness of the water increased , and studies conducted to determine the effect of water hardness on human health show there are mixed results and some have confirmed that there is an inverted relationship between water hardness, heart disease, vascular disease and its impact on the balance of minerals in the body, we find that the lack of magnesium in the water causes due to diseases such as asthma, migraine, cramps and other because the deficiency works to inhibit the action of enzymes and high blood pressure and cardiovascular diseases.

And 99% of body calcium is found in bones and teeth and what remains of it is used in metabolic processes, and the lack of calcium intake is accompanied by coronary artery disease and kidney stones.

4-results of the analysis indicated in Table (4.1) show that the percentage of phosphate in Arquette, Alsahafa, Japrah and African University is higher than normal levels phosphate in the water by the World Health organization and Sudanese specifications standard. In Table (2.3) and (2.4). we find that the phosphate produced from agricultural fertilizers is increasingly used because of limited arable soil for agriculture and the resulting water pollution of fertilizer if they were used in a manner not calculated used in uncalculated manner which leads to the increase of the plant needed, melt in the irrigation water that is disposed of in sewage or accumulate over time to reach the Ground water. The phosphate compounds of the most important water pollutants, where the consequences for an increase in the water they harm the lives of many of the organisms that live in the water, and is make excessive growth of algae, and are reducing the proportion of oxygen in water and it`s toxic compounds to humans and animals, and we find that the DNA , RNA containing phosphate if increased in concentration leads to increased proliferation of organisms in water specially algae , this is called a bloom of algae, and this phenomenon obscured the sun's rays on the water, which reduces the photosynthesis process of plants and oxygen concentration decreased as well.

5- The analysis also showed that the amount of dissolved salts TDS in the area (Jabrah station Taha al-Mahi), up from the limit and this could be attributed to several reasons including soil and rocks rich in many of the salts or waste, agricultural and industrial. The high amount of dissolved salts in drinking water to many things, such diseases, change in blood pressure and the formation of gallstones and dehydration, the gallstones composed of calcium or uric acid, and sometimes consist of a mixture of various salts in certain Medias where water is alkaline.

6- The most common and widespread health risks associated with drinking water is microbial bacterial contamination which always be given a priority to the improvement and development of sources of drinking water, which represents the greatest risk to public health microbial. pollution and bacterial networks cities are possible to pass the disease on a large area among consumers and quickly.

Tests on water samples at (Arkwait, Alsahafa, Japrah and Africa University) have shown that that a high percentage of the BOD have shown. This test Index to water pollution of the state of South Khartoum with fecal matter and the existence of other types of micro-organisms that cause diseases such as viruses and parasites that are resistant to disinfection, and some types cause bloody diarrhea and others inflammation of the urinary tract and other diseases and half the children under the age of five are more likely to be infected by of these diseases so it should not be present in drinking water in any way, and this is confirmed by the World Health organization standards and Sudanese specifications for drinking water in table (2.3) and (2.4).

Chapter FIVE

Conclusions and Recommendations

Chapter Five

Conclusion and Recommendation

5.1 Conclusions:

This is what finally reached, it`s a human exertion can be increased and decreases, and through the study we found that the water of South Khartoum State unfit to drink and this is attributed the reason for the high phosphate ratio and decrease of the alkaline water for the required limit in certain areas and rising in the other as well as decrease and increased the total hardness from the allowable limit, and also a rise in the quantity of dissolved salts in some places in the state south of Khartoum and the presence of a high percentage of pathogenic bacteria and the study recommends to stay away from drinking water some of the state of South Khartoum areas.

5.2 Recommendations:

It is known that drinking water is the most important basics of life for human beings and cannot be replaced by an alternative material, therefore it must be characterized by qualities so as not to leave any negative effects on human health, and this requires it to be free of any contaminants that chemical, physical and microbial properties must be inspected and checked with the utmost accuracy and transparency, to achieve these purposes, we recommend the following:

1. Selection of the appropriate area to drill wells so the floor must be layered with the ability to appropriate filtration and depth and are far from waste water sources.

2. Use caution when neighboring farms channels pesticides that have a harmful impact on human health. As well as the protection of the channels of contamination from human and animal waste.

3. Leave a chemical treatment carried out on the water for the side effects and the use of a substitute for Moringa tree, which some research has shown its effectiveness and lack of side effects

4. use to transport water from the Nile to the pipes and treatment plants to reduce turbidity and pollution.

5. Use skilled labor in treatment plants and conduct the tests.

6. Conventional treatment development.

7. Establish a modern processing and testing to determine the validity of the water and the development of radical solutions to the waters of the state of South Khartoum station.

8. vital interest in topics about search

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Appendices

Palte (A): Paqualab Photometer

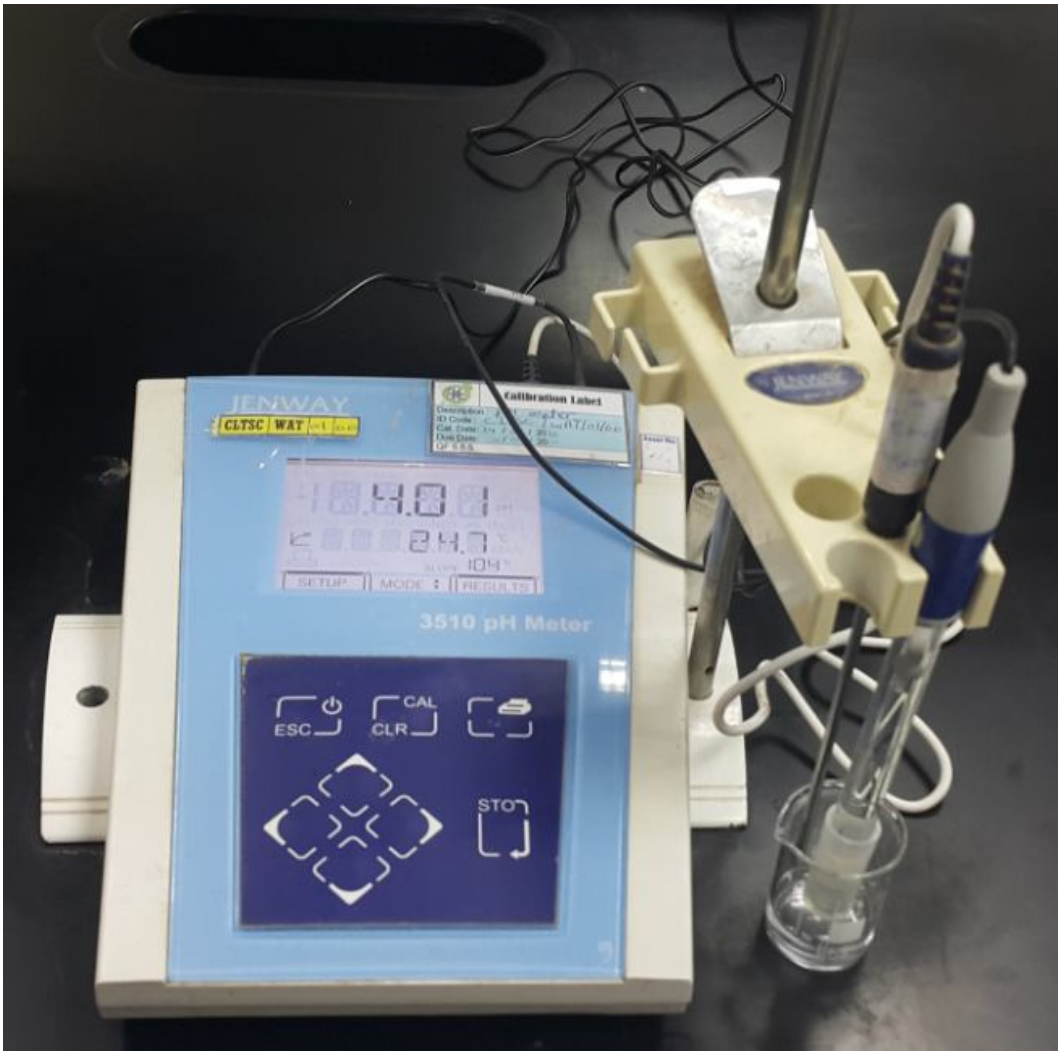
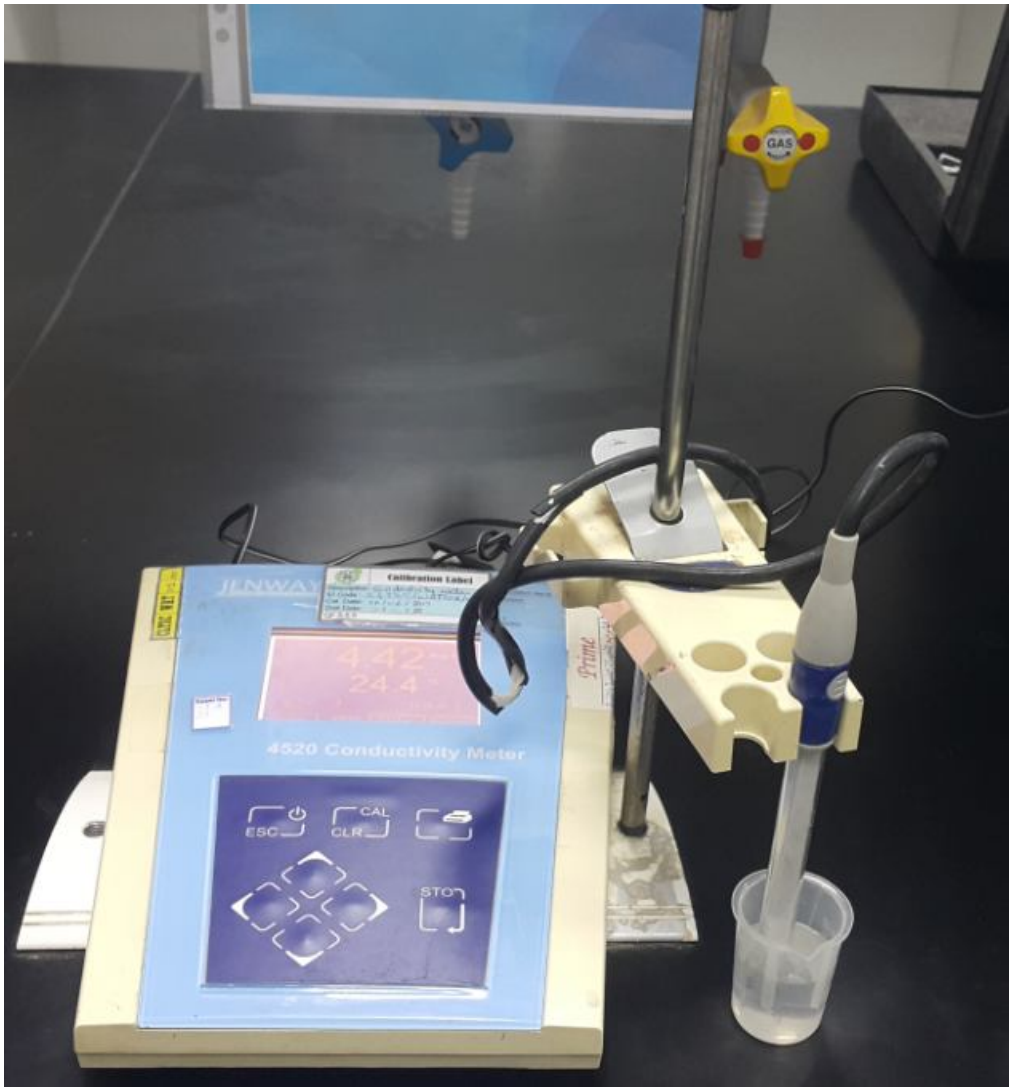


Plate (B): (3510) PH Meter



Palte (C): 4520 Conductivity meter

Palte (D): PFP7 Flame Photometer

Palte (E): Spetrophotometer